currents, and remain only as short lengths of particles held together. To throw light on this possibility, a small vertical, hollow cylinder of plaster of Paris open above was arranged with iron electrodes (for forming an arc) passing through its sides and meeting in the centre. By passing the current of a storage battery giving about 50 volts through them in contact and separating them, an iron arc could be produced at will within the plaster cylinder. The dimensions of the cylinder were such that a microscope slide 3 in. by 1 in. could rest across the open upper end of the plaster cylinder, only partly closing it, the slide lying horizontally above the arc electrodes at a distance of about 3 cm. Such a slide could receive a layer of smoke on its under-surface when the arc was formed below it. The microscope in that case showed only a confused deposit.

When, however, there was placed above the slide a strongly excited electromagnet with its poles resting on the upper sides of the slide or close thereto, such poles being about 3 cm. apart, a smoke deposit of a remarkable character was produced. Even as examined by the unaided eye in diffused light there was decided evidence of a structure or striation. When the microscope was used, with even comparatively low powers of about 300–400 diameters, there was disclosed a decided striation seemingly composed of brownish particles in strings extending over the slide and following the direction of the field. There was noted a surprising regularity in the distribution or spacing of the striæ, as if the surface was covered with fibres laid on systematically side by side.

There were, however, curious objects composed of small spheres (evidently globules of iron) strung together in a line of two, three, four, or more, such spheres having no uniform size. Most of these iron globule groups lay, of course, in the field direction, and were very large relatively to the particles in the striation covering most of the surface of the slide. But each of these straight settings of globules possessed a singular appendage, generally at one end only, but sometimes at both ends. It consisted of a brush-like tail composed of the brown filamentous chains of particles like those covering the slide as noted above. They gave the appearance of tufts, suggesting a growth of fine beaded fibres from the end of the string of globules. By focussing, these tufts or tails could be seen as projecting outward (upward) in an inclined direction. This means that the tufts did not lie on the slide surface, but sprang outward from the globule which carried it. The globule at the other end of the short chain (generally the largest in the line) was often to be seen as having a convergence upon it of the usually parallel striæ of the other parts of the slide, indicating clearly that the globules strung together were acting as small magnets with poles at each end, towards and from which poles the convergence and divergence of the magnetic lines were indicated by the fine striæ of particles taking their direction.

The polariscope showed that the striated smoke layer caught on the slide has the same property of scattering or diffusing light (as plane polarised light) that the smoke oriented in the air by a magnetic field has, but, of course, the slide preserves the orientation, and needs, to produce the results, no magnetic field after its formation or deposition. The slide covered with the striated smoke film is, in fact, a polariser.

Examination between crossed Nicol prisms (dark field) discloses the fact that the tufts of fine fibres carried by the rows of globules show as luminous spots on the black field, clearly indicating that the groups or tufts have a polarising effect if they are in proper relation to the rays passing through.

As was to be expected, any hollow vessel or enclosure capable of retaining the smoke from an iron arc can be used in demonstrating the original luminous phenomenon. A glass flask of from 1 to 2 litres is readily sensitised, as it were, by holding its mouth over an iron arc for a short time, allowing smoke from the arc to enter, and then corking the flask. It may then be used to show the effects by allowing a beam of light to traverse it while held in the field of a current-carrying coil. While this was being done it was noticed by Dr. Hollnagel (of the laboratory) that when the coil was traversed by an alternating current of twenty cycles the flask, when near the coil, gave the usual effect of increased luminosity of the smoke in its interior. When, however, the flask was removed from the coil a distance of several feet the steady luminosity was replaced by a flickering which kept pace, not with the alternations of current in the coil, but with the cycles only. The flickering was, as it appeared, at the cyclic rate. This flickering was noted even at a distance of 12 ft. from the coil, although the coil was but 7 in. in diameter and about 2 in. in axial direction. The flickering is a curious effect, and it is difficult to explain, especially the fact that it appears to keep time with the cycles, and not with the alternations, of current. It points to some sort of magnetic retention or polarisation of the iron particles of the smoke. They may even rotate or oscillate in obedience to the field fluctuations, but there is needed much more work of investigation as to the cause of the peculiar behaviour. The experiment clearly shows that a very moderate field intensity suffices for lining up the particles in the air, and so producing the luminous effect.

Emphasis is again given to the fact of the extremely small amount of iron particles suspended in the air capable of giving a decided effect.

ELIHU THOMSON.
Thomson Laboratory, Lynn, Mass., June 17.

The Japanese Artificially Induced Pearl.

THE subject of artificial pearl induction, I venture to suggest, affords an excellent example of comparative pathology. Dr. Lyster Jameson's diagram in NATURE of May 26, p. 396, might well pass as an illustration of "pearls" frequently found in the human body. Such "pearls" are commonly seen in papillomata of the skin and at muco-cutaneous areas, but they can also be demonstrated in the tonsils, brain-coverings, thymus and thyroid glands, etc. Those which are epidermal become keratinoid, but others of deeper origin are often calcified.

All "pearls," whether ostreal or human, start in columnar cells and undergo metaplastic changes. Those of a wart become horny; those of the oyster calcified. The histological changes in the oyster are simply a matter of degree, and not difference.

The diagram fully illustrates this. The "blister" if seen in horizontal (transverse) section would present the same features as seen in the "pearl"—a concentrically laminated core surrounded by a single layer of cubical cells, embedded in mesoblast if growing, but when growth stops the cubical layer would be no longer seen.

"Islands" or "rests" of epithelial elements are common in man. In the oyster such an inclusion may become the true pearl and grow like a wart. Artificial induction or grafting merely imitates the natural process, and its later history is simply a matter of slight change in degree. In either case the pearl must be viewed as a morbid structure due to focal irritation. It is held that a wart may become malignant. In

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other words, it may grow too fast and eventually kill the host.

Do the pearl elements ever behave so in the induced variety?[1] Should any positive evidence of this be available, it would throw much valuable light upon the ontogeny of cancer.

The view that warts, and even cancers, are transplantable is strongly supported by the artificial induction of pearls.

WYATT WINGRAVE,
Consulting Pathologist, Central London Throat and Ear Hospital.
Lyme Regis, Dorset, July 8.

I DIRECTED attention in my 1902 paper (Proc. Zool. Soc., March 4, 1902) to the resemblance between pearls and "the structures sometimes found in epidermoid tumours and atheroma cysts." A pearl might be compared to the concentrically deposited ball of desquamated epithelial cells characteristic, I believe, of the latter, except for the fact that the pearl (like the normal molluscan shell-substance, and unlike the outer layer of the skin, and the nails, horns, hair, etc.,

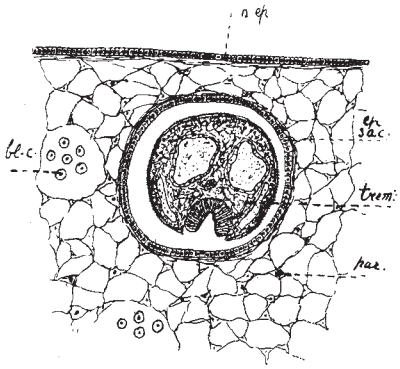

FIG. 1.—The pearl-inducing trematode *Gymnophallus dapsilis* or *G. bursicola* in the sub-epidermal connective tissue of Mytilus, surrounded by an epidermal sac which becomes the pearl-sac: *o. ep.*, outer shell-secreting epidermis; *ep. sac.*, epidermal pearl-sac; *par.*, parenchymatous connective tissue; *bl. c.*, blood-cells; *trem.*, trematode. The sac is usually about 0·4 to 0·5 mm. in diameter.

in mammals) is not composed of cells, but secreted at the surface of cells.

I cannot agree that the difference between a blister and a pearl is one of degree and not of kind, as Dr. Wingrave seems to suggest; in spite of the fact that the nature of the secreting cells, and of the substance they secrete, is identical. The blister is the normal response of the outer shell-secreting epidermis to the mechanical stimulation of any body that comes in contact with it. In this sense it resembles a corn on the human foot, or the thickenings of the skin on a navvy's hands. On the other hand, recent evidence goes to show that the sac, or "island," of epidermis in which the pearl is formed arises only in certain quite *specific* circumstances. In the case of the edible mussel the "circumstance" is probably the specific stimulation (quite likely of a chemical nature) of the trematode *Gymnophallus dapsilis* or *G. bursicola*. These worms normally become surrounded by such a sac in Mytilus (Fig. 1), and when the worm dies, or leaves the sac, a pearl is formed in it. A smaller trematode, which I have not identified, also occurs in the sub-epidermal connective tissue of the mussel; but this species, which is surrounded by a cyst, probably secreted by the worm itself (Fig. 2), and not by an epidermal sac, does not, in my experience, give rise to pearls. Similarly the cestode larva (*Tylocephalum ludificans*), which was wrongly identified by Herdman, Shipley, and Hornell as concerned with pearl formation in the Ceylon pearl oyster, is surrounded by the oyster with a fibrous con-

[1] The step from a "pearly" wart to a "pearly" or nested epithelioma is a very short one.

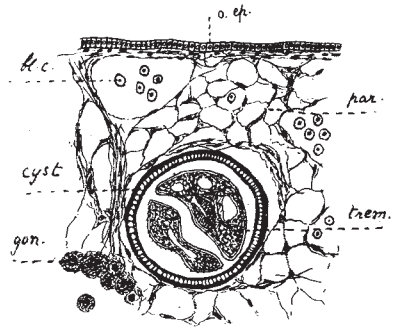

FIG. 2.—A smaller (unidentified) trematode in the sub-epidermal connective tissue of Mytilus which is surrounded by a cyst, probably secreted by the worm itself. The mollusc does not surround the worm with an epidermal sac, and there is no evidence that this species of trematode ever becomes the centre of a pearl: *gon.*, gonad. Other letters as in Fig. 1. The cyst is about 0·15 mm. in diameter.

nective tissue capsule (Fig. 3), and does not appear to possess the power of provoking the mollusc to produce the epidermal sac in which alone a pearl can be formed.

In the case of the Mikimoto pearls and of the pearls artificially produced by Alverdes, the special "circumstance" is the performance of a particular transplantation of tissue.

One of the facts which have favoured the survival

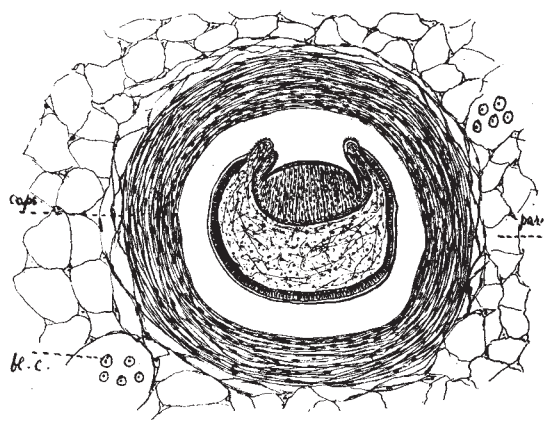

FIG. 3.—Solex of the cestode *Tylocephalum ludificans* in the connective tissue of the Ceylon pearl oyster. The mollusc surrounds this worm with a capsule (*caps.*) of fibrous connective tissue instead of with an epidermal sac. In spite of statements to the contrary, no satisfactory evidence has been adduced that this worm is associated with pearl formation. Letters as in Fig. 1. The entire capsule may measure as much as 2 or 3 mm. in diameter.

of the theory that the same kind of mechanical stimulation that produces a blister can produce a pearl-sac and a pearl is the occasional presence in fine pearls of grains of sand and other foreign bodies. I recorded and figured several such instances, from Ceylon pearls, in my 1912 paper (Proc. Zool. Soc., 1912, pl. xlii., Fig. 38; pl. xliii., Figs. 44, 45; pl. xlv., Figs. 54, 54*a*; pl. xlvi., Figs. 55, 56). I suggest the following possible explana-

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